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BIOLOGICAL EFFLUENT PURIFICATION AT CHERVONOZNAMEN SUGAR PLANT

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Owing to the large void surfaces and good air circulation conditions inside the lump packing, the oxidizing capability of the installation is significantly increased [2]. In final selection of the type of installation, it was considered that, with a significant effluent BOD, it was advisable to use tall biological filters, which permit the contact time of the liquid with the biological film and air to be increased and, as a consequence of this, the percent mineralization of the pollution to be increased [3].

Fig. 1. Very high biological filters of purification installation at Chervonoznamen Sugar Plant.

The foam glass used as the packing material has all the advantages of lump packing.

The technological scheme of the artificial biological purification (Fig. 2) provides for separate mechanical purification of industrial effluents of the third category and of housekeeping-fecal effluents. The third category effluents, together with the transport-washing water residues, enter earthen settling basins, for precipitation of suspended matter. As these waters are clarified, they are sent to storage ponds, which are used to regulate the flow rate and effluent accumulation in the

production season.

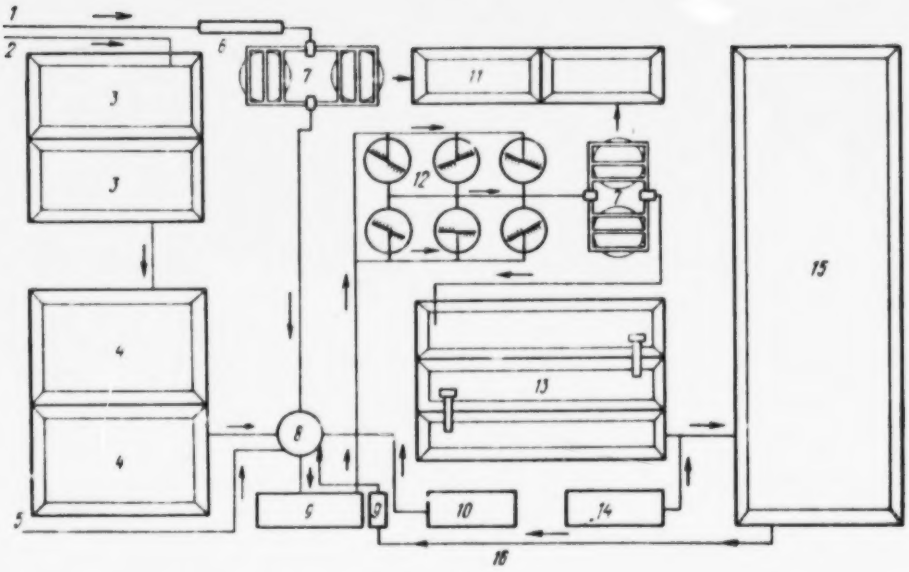

Fig. 2. Diagram of purification equipment at Chervonoznamen Sugar Plant: 1. housekeeping-fecal waters; 2. production waters; 3. earthen settling tanks; 4. storage ponds, 5. hot water of the plant; 6. sandtrap; 7. settling tanks; 8. reservoir; 9. pump; 10. biogenesis; 11. sludge areas, 12. turret biological filters; 13. biological reservoirs; 14. chlorinator; 15. pure water ponds for the plant; 16. water for dilution.

The housekeeping-fecal effluents are enriched with biogenous materials, diluted and mixed with production waters in the pumping station receiving reservoir, before delivery to the turret biological filters. The purification installation includes a biogenous additive station, since after mixing housekeeping waters with industrial, the nitrogen and phosphate content in the effluents remains insufficient. Part of the finally purified effluents from the pure water ponds and hot barometric water also is delivered to the receiving pond by pumps.

The former are necessary to decrease the BOD concentration (dilution) of the effluent delivered to the biological filters and the latter, besides dilution, makes it possible to increase the effluent temperature and, owing to this, the oxidation rate.

The barometric water is delivered to the receiving reservoir during the period of operation of the plant. In the wintertime, after shutdown of the plant until March, the required temperature inside the biological filters is maintained by means of heaters. Air heated by the heaters rises upward; therefore, there will always be warm air between the biological filter coating and the surface of the packing material and, by distribution of the effluent over the surface of the packing material, it will be heated. These measures to dilute and heat industrial effluents permits the pollution concentration to be decreased from a BOD_{20} of 3000 to 600-800 mg/l, and the effluent temperature to be increased from +8° to +15°C, ensuring a normal year-round operation of the filters with constant efficiency, with a total load of all biological filters of up to 130-135 thousand m^3 per month. The capacity of the biological filters is calculated in such a way that, in the period between seasons of plant operation, the discharge effluents are processed and the earthen settling tanks and storage ponds are empty by the start of the new production season.

After purification in the biological filters, the effluents enter secondary settling tanks, for removal of biological film washed off by them. The clarified liquid is sent for after-purification to biological ponds, to decrease the BOD_5 from 15-20 to 2-3 mg/l and, further, to clean water storage ponds, from which it is taken for technological (return)

water supply of the plant.

Before packing into the filters, openings 26-30 mm in diameter, at distances of not over 20 mm apart are drilled in the foam glass lumps. With this accomplishment, the packing has an actual adsorption surface of 150 m^2/m^3 (in place of the initial geometric 70 m^2/m^3) and a void percent of 60. Drilling of the foam blocks is carried out in a vertical drill press. One worker per shift processed 2.5-3.0 m^3 of blocks. After drilling, the blocks were delivered to the biological filters by a special crane, and they were packed one on the other.

The cost of preparation and laying the packing was approximately 60 rubles per m^3. Technical-economic calculations, carried out by the Ukrgiprosakhar Institute, showed that the use of the proposed new purification scheme makes it possible to obtain appreciable savings. Economic index data, for a 3000-ton per day capacity of sugar beet processing are presented in the table.

a Очистные сооружения	b Капиталовложения, тыс. руб.	c Потребная электроэнергия, квт·ч	d Эксплуатационные затраты	e Приведенные затраты	f Стоимость очистки 1 м³ сточных вод, руб.	g Занимаемая площадь под очистные сооружения, га
h С биопрудами	3178	149	402	879	1,13	125
i С аэротенками	1752	811	296	559	0,72	70
j С биофильтра без пеностекла	1654	242	200	450	0,52	28
k С полями фильтрации	2418	69	289	650	0,84	100

Key: a, Purification Installations
b, Capital Expenditure, thousand rubles
c, Electric Power Consumed, kW·hr
d, Operating Costs
e, Corrected Costs
f, Cost of Purification of 1 m^3 of Effluent, Rubles
g, Area Occupied by Purification of Equipment, hectare
h, With biological ponds
i, With aeration tanks
j, With biological filters without foam glass
k, With filtration fields

Purification installations were built at the Khodorov sugar combine, by a similar technological scheme of artificial biological purification of effluents.

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